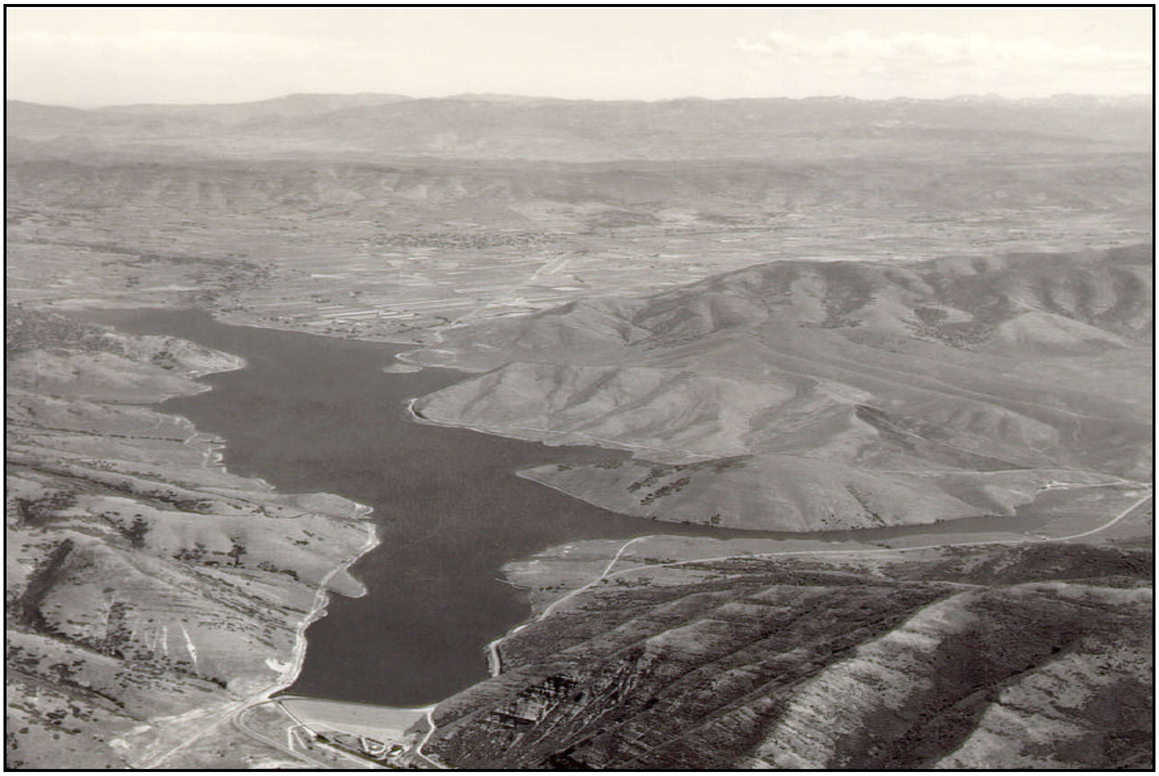
DEER CREEK RESERVOIR



Introduction

Deer Creek Reservoir is a large reservoir at the top of Provo Canyon in northern Utah. Much of the Wasatch fronts and Salt Lake City's water comes from this reservoir, and it is a popular destination for year-round recreation. The Heber Creeper, a tourist passenger railroad, follows the reservoir's northern shore, and US-189 follows the southern shore. It impounds spring runoff from the western Uintas, storing it for use throughout the year. Deer Creek Reservoir was created in 1941 by the construction of an earth-fill dam. The reservoir shoreline is publicly owned, and public access is unrestricted. It is named after Deer Creek, which flows into the Provo River immediately downstream from the dam. In addition to recreational usage the reservoir water is used for irrigation (38%), and culinary (62%). As urban sprawl continues to cover farmland, the amount consumed for culinary purposes is expected to increase.

Characteristics and Morphometry

Lake elevation (meters / feet)	1,651 /5,417
Surface area (hectares / acres)	1,200 / 2,965
Watershed area (hectares / acres)	187,000 / 462,000
Volume (m^3 / acre-feet)	
capacity	2.38823×10^8 / 193,614
conservation pool	1.850×10^8 / 149,700
Annual inflow (m^3 / acre-feet)	4.930×10^8 / 254,700
Retention time (years)	1.3
Drawdown (m^3 / acre-feet)	8.6854×10^7 / 70,413
Depth (meters / feet)	
maximum	42 / 137
mean	20 / 65
Length (km / miles)	9.2 / 5.7
Width (km / miles)	1.9 / 1.2
Shoreline (km / miles)	29.6 / 18.4

Location

County	Wasatch
Longitude / Latitude	111 32 58 / 40 24 45
USGS Maps	Aspen Grove, 1948, Charleston, 1966
DeLorme's Utah Atlas & Gazetteer™	Page 53 C-6, 54, C-1
Cataloging Unit	Provo River (16020203)

Recreation

Deer Creek Reservoir is easily accessible from US-

File Contains Data for PostScript Printers Only between Provo and Heber. The highway crosses the dam and follows the shore for about five miles. There are several resorts and one state park along the route. The road will be in the process of reconstruction from about 1995 to 2000, rerouting the highway further from the reservoir and providing improved access and parking.

Cross-country skiing, fishing, boating, windsurfing, swimming, camping, picnicking, ice fishing, and water skiing are all popular. Fishing is generally good to excellent, and strong canyon winds create fine sailing conditions. Mount Timpanogos and the rest of the southern Wasatch Front provide a spectacular backdrop. Timpanogos itself is discernable from the north end of the reservoir, with her head and flowing hair at the south end of the mountain.

Recreational facilities at the reservoir include Deer Creek State Park as well as private recreational facilities and marinas. The state park has a concrete boat launch, modern rest rooms with showers, sewage disposal, a 31 unit campground, and fish cleaning stations. The park is located two miles north of the dam on US-189 (milepost 20) with well-marked entrances.

Private facilities include Snow's Marina in Wallsburg Bay (milepost 21), the Deer Creek Island Resort (milepost 24) with a restaurant, boat rentals, boat launch areas, picnic areas, swimming areas, gasoline and sundries. An additional state-owned beach facility with swimming areas and public rest rooms are just north of the resort.

There are numerous USFS campgrounds up the North Fork up Provo Canyon on U-92, and Wasatch State Park in Midway (north of the reservoir and US-189 in the Heber Valley) also offers camping.

Watershed Description

Deer Creek Reservoir an impoundment of the Provo River. The river has a long narrow watershed, from the Trial Lake area in the extreme western Uintas down into the southern end of Kamas (Rhodes) Valley, then down upper Provo Canyon into the Jordanelle Reservoir, across Heber Valley and into Deer Creek Reservoir, which is located where Heber Valley narrows into Provo Canyon.

The area around the reservoir is sage-grass vegetation, with agricultural crops where the reservoir borders Heber Valley.

The inclusion of the western Uintas into the Provo River's watershed is a result of several natural and man-made diversions. In fairly recent geological times, the Provo River only drained the Heber Valley. Upper Provo Canyon was an east-flowing tributary of the Weber River, and what is now the headwaters of the Provo River drained across Kamas Valley and down the Weber. As geologic tilting and faulting occurred, the Heber Valley became topographically lower then Kamas Valley, and tributaries of the Provo River began capturing drainage from the Weber Basin. One of these tributaries began capturing the east flowing, present- day Upper Provo Canyon. It eventually captured that entire canyon (its east flowing tributaries are testament that the stream once flowed east) and reached the southern Kamas Valley and diverted the stream which is now called the Provo River into the Provo River drainage. Presently, the Provo River and Weber River both flow through Kamas Valley. The Provo has cut a narrow channel within the otherwise flat valley, but no further drainage has been captured. It appears that at the moment of human's brief presence in geologic time, the more difficult part of the capture (tough bedrock underlying Upper Provo Canyon) has occurred, but the Provo drainage has not made progress in capturing the remainder of the Weber River tributaries in Kamas Valley (underlaid by soft alluvial deposits), a process that should be nearly instantaneous. It has taken at least 10,000 years, however, because the width of Upper Provo Canyon clearly indicates it has carried glacial runoff.

Since Europeans arrived in the area, they have made two additional diversions to the headwaters of the Provo River. The first was the relatively simple diversion of Weber water across Kamas Valley to the Provo. This approximately doubled the watershed in the Uintas. Only a relatively small fraction of the Weber River is diverted, though. The second diversion involved tunnelling through the mountains between the Duchesne River and the Provo River. This diverts water from the Colorado River watershed to the Wasatch Front.

The natural watershed high point, Bald Mountain, is 3,640 m (11,943 ft) above sea level, thereby developing a complex slope of 3.7% to the reservoir (although higher points exist in the Duchesne River watershed). The average stream gradient above the reservoir is 3.2% (170 feet per mile). The inflows are the Provo River, Main Creek and Daniels Creek. The outflow is the Provo River.

Culinary water stored in the reservoir is diverted from the river several miles downstream at the Olmstead Diversion into the Salt Lake Aqueduct, while irrigation water is diverted near the mouth of the canyon at the Murdock Diversion. The newly completed Jordanelle Reservoir is the only significant upstream impoundment.

The watershed is made up of high mountains, low mountains, and valleys. The soil associations that compose the watershed are listed in Appendix III.

The vegetation communities consist of pine, spruce-fir, oak-maple, alpine tundra, and sagebrush-grass. The watershed receives 41 - 102 cm (16 - 40 inches) of precipitation annually. The frost-free season around the reservoir is 80 - 100 days per year.

Land use is primarily multiple use in USFS and BLM owned lands, and grazing of domestic livestock on privately owned lands. Private lands in the Heber Valley, however, are primarily agricultural, suburban, and urban. The headwater area of the Duchesne River is in the High Uintas Wilderness.

Limnological Data

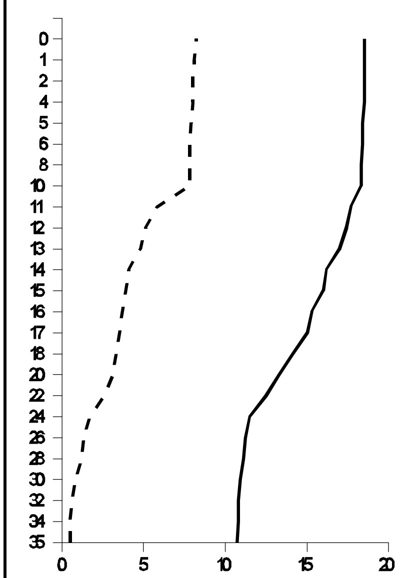
Data sampled and averaged from STORET sites on a year-round schedule: 591322, 591323, 591324, 591343, 591345.

Surface Data	1980	1990	1991*	1992*
Trophic Status	E	M	M	M
Chlorophyll TSI	52.18	48.12	53.92	45.13
Secchi Depth TSI	48.00	41.98	47.15	44.71
Phosphorous TSI	56.72	50.28	47.73	46.48
Average TSI	52.30	46.79	49.60	45.44
Chlorophyll a (ug/L)	-	6.5	14.0	4.2
Transparency (m)	2.57	3.5	2.7	3.1
Total Phosphorous (ug/L)	25	24	20	25
pH	8.2	8.2	8.1	8.4
Total Susp. Solids (mg/L)	<5	2.4	3.4	1.8
Total Volatile Solids (mg/L)	-	-	-	-
Total Residual Solids (mg/L)	-	-	-	-
Temperature (ºC / ºf)	20/68	19/66	19/68	19/66
Conductivity (umhos.cm)	370	384	321	418
Water Column Data				
Ammonia (mg/L)	0.16	0.06	0.04	0.03
Nitrate/Nitrite (mg/L)	0.23	-	0.15	0.06
Hardness (mg/L)	171	187	181	-
Alkalinity (mg/L)	131	-	-	-
Silica (mg/L)	9.8	-	-	-
Total Phosphorous (ug/L)	28	43	23	36
Miscellaneous Data				
DO (Mg/l) at 75% depth	0.0	1.1	0.5	1.3
Stratification (m)	NO	NO	NO	NO
Limiting Nutrient	N	N	N	N
Depth at Deepest Site (m)	40	35.0	35.0	35.0

* Data from all five sites were used in calculations.

Limnological Assessment

The water quality of Deer Creek Reservoir is good. It is considered to be hard with a hardness concentration value of approximately 180 mg/L (CaCO3). The only parameters that have exceeded State water quality standards for defined beneficial uses are phosphorus, dissolved oxygen and on rare occasion total coliforms. Although the average surface concentrations of total phosphorus have not exceeded the State pollution indicator for phosphorus of 25 ug/L it is not unusual for the concentration throughout the water column to exceed is value several times due in large part to the higher concentrations that develop in the hypolimnion after the reservoirs stratifies and anoxic conditions develop. These types of conditions allow for the reintroduction of phosphorus previously stored in the sediments. Dissolved oxygen concentrations in late summer consistently substantiate the fact that water quality impairments do exist. Concentrations dropped dramatically in the hypolimnion to a low of 0.5 mg/L as depicted by the July 14, 1992 profile. Historically the reservoir has exhibited fairly high eutrophic conditions. During the late 70's and early 80's the reservoir was characterized as a highly eutrophic system with heavy algal blooms and the problems associated with them. The TSI values during that period averaged over 50 with reported values of 53.5, 54.2 and 54.2 in 1975, 1981 and 1982 respectively. This deterioration of water quality became the catalyst for joint activity by several agencies, groups and private land owners to study the problems and find acceptable solutions to alleviate the problems and restore water quality. These efforts have been ongoing since the 1980's. Projects have been implement to control the discharge of point and nonpoint sources of nutrients (primarily phosphorus) throughout the Deer Creek Reservoir watershed. Efforts were primarily focused on municipal wastewater and fish hatchery discharges, dairy operations, erosion control and proper planning with an increase in development in the watershed. Through these combined activities nutrient loadings to the reservoir have been decreased and water quality has improved. Although there is an extensive amount of data that has been collected a review of TSI values and the phytoplankton commnunity support these conclusions. TSI values have steadily declined from the historical values near 54.2 to 49.28, 46.79, 48.41, 45.65 and 43.14 from 1989 through 1993. In addition the phytoplankton community dominance has shifted from a blue-green to a green algae dominance with an increase in diatom diversity. All the periods of record indicate that the reservoir is characterized as a nitrogen limited system. From a complete review of profiles during the summer months it is evident that the reservoir does stratify. These



D	°C	pH	DO	Cond
0	18.5	8.1	8.2	393
1	18.5	8.1	8.1	393
2	18.5	8.1	8.0	394
4	18.5	8.1	8.0	394
5	18.4	8.1	7.9	394
6	18.4	8.1	7.8	394
8	18.3	8.1	7.8	394
10	18.3	8.1	7.8	394
11	17.7	7.8	5.8	394
12	17.4	7.6	5.1	394
13	17.0	7.5	4.8	395
14	16.2	7.4	4.1	393
15	16.0	7.4	3.9	391
16	15.3	7.3	3.7	392
17	15.0	7.3	3.5	392
18	14.1	7.2	3.3	394
20	13.3	7.2	3.1	402
22	12.5	7.2	2.6	405
24	11.5	7.1	1.7	416
26	11.2	7.1	1.3	417
28	11.1	7.1	1.2	418
30	10.9	7.1	0.8	417
32	10.8	7.1	0.6	422
34	10.8	7.1	0.5	422
35	10.7	7.0	0.5	420

Temp DO

conditions are deleterious to not only to the fishery by rendering some of the water column unsuitable for a fishery, but water downstream from the reservoir unsuitable for a cold water fishery until the dissolved oxygen concentrations increase to a point when they can sustain a fishery. According to DWR no fish kills have been reported in recent years. The reservoir supports populations of rainbow trout (Oncorhynchus mykiss), cutthroat trout (*Oncorhynchus clarki*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), yellow perch (*Perca flavescens*), brown trout (*Salmo trutta*), carp (*Cyprinus carpio*) and chubs (Gila atratia). Walleye (*Stizostedion vitreum*) and crayfish have been illegally introduced into the reservoir. DWR typically stocks the reservoir with fry, fingerling or subcatchable rainbow and cutthroat trout and smallmouth bass.

Macrophytes are not typically present and are not a problem. Traditionally, the DWR has stocked 100,000 fingerling Smallmouth Bass in the spring and nearly 100,000 subcatchable Rainbow Trout in both the spring and the fall. By the early 1990's, the Walleye population (illegally introduced) had become so dominant in the reservoir that
it wiped out most of the trout fishery. In 1992, the DWR ceased to stock trout, and now stocks only the 100,000 Smallmouth Bass. Fish populations are very dynamic from year to year, with Walleye being the predominant predator in the early 1990's.

The reservoir has not been chemically treated by the DWR to eliminate rough fish competition, so populations of native Provo River fish may be present. Intensive stocking and angling for over 50 years have probably driven native fish populations to very small numbers.

Phytoplankton in the euphotic zone include the following taxa (in order of dominance)

Species	Cell Volume (mm^3/liter)	% Density By Volume
Aphanizomenon flos-aquae		12.888
68.84		
Stephanodiscus niagarae		3.914
20.91		
Anabaena spiroides		
var. crassa	1.557	8.32
Oocystis sp.	.175	0.94
Melosira granulata	.109	0.58
Asterionella formosa	.069	0.37
Pennate diatoms	.004	0.02
Ankistrodesmus falcatus	.004	0.02
Total	154.917	
Shannon-Weaver	0.89	
Species Evenness	0.43	
Species Richness	0.30	

This sampling of the phytoplankton is representative of July 14, 1992 and is not typical of the decreasing trend for dominance by blue-green algae.

According to Rushforth (1992) the algal plankton flora of Deer Creek Reservoir, Wasatch County, Utah was studied throughout the 1991 calendar year. Quantitative net plankton and total plankton samples were examined. A total of 45 taxa was identified in the plankton flora. In addition, the two common categories, centric diatoms and pennate diatoms, each contain many additional taxa.

The most important plankters as determined by calculating Important Species Indices (Isis) from all Deer Creek Reservoir combined net and total plankton samples collected during 1991 were *Fragilaria crotonensis*, *Aphanizomenon flos-aquae*, *Stephanodiscus niagarae*, *Sphaerocystis schroeteri*, *Melosira granulata*, pennate diatoms, *Pandorina morum* and *Ankistrodesmus falcatus*. These taxa all had Isis greater that 1.0. These eight taxa comprised 92.7% of the phytoplankton flora (as determined by calculating sum importance value) of Deer Creek Reservoir for the 1991 year. This measurement is an assessment of algal standing crop and distribution through the year as reflected in our samples.

Algae with ISI's greater that 0.10 included centric diatoms, *Microcystis aeruginosa*, *Staurastrum gracile*, *Anabaena spiroides var. crassa*, *Dinobryon divergens*, Asterionella formosa, Ceratium hirundinella, Chlamydomonas species, and *Pediastrum duplex*.

Bluegreen algae together comprised approximately 17.2% of the flora when measured by summing ISI's. This total represents a significant increase over the past few years. For example, bluegreen algae comprised only 1.5% of the flora for the 1990 year. *Aphanizomenon flos-aquae* was the most important cyanophyte in the reservoir for 1991 with an important species index of 6.77 (up from an ISI of 1.79 for the 1990 year). A. flos-aquae was also the second most important organism in the reservoir after the diatom *Fragilaria crotonensis*. The increase in abundance of A. flos-aquae continues a trend of rebound of this organism during the past two years.

Deer Creek, historically is a meso-eutrophic to eutrophic ecosystem. The reservoir has responded well to the nutrient limitation program established several years ago. The presence of noxious, poor water quality indicator species continues to be reduced compared to their abundance in the reservoir prior to nutrient limitation although the rebound in *Aphanizomenon flos-aquae* is noteworthy. It will be important to follow the development of this organism in the reservoir system during the 1992 year.

Pollution Assessment

Nonpoint pollution sources include the following: Sedimentation and nutrient loading from grazing. Human wastes, chemicals and nutrients from urban areas. Herbicides and nutrients from cropland. Human wastes, litter and toxins from recreation. Siltation from road construction during the late 1990's.

Point sources of pollution in the watershed include the following:

Midway Fish Hatchery
Kamas Fish Hatchery

Beneficial Use Classification

The state beneficial use classifications include: culinary water (1A), recreational bathing (swimming) (2A), boating and similar recreation (excluding swimming) (2B), cold water game fish and organisms in their food chain (3A) and agricultural uses (4).

Information

Management Agencies	
Mountainlands Association of Governments	377-2262
Division of Wildlife Resources	538-4700
Division of Water Quality	538-6146
Recreation	
Mountainland Travel Region (Provo)	377-2262
Heber Chamber of Commerce	654-3666
Provo-Orem Chamber of Commerce	224-3636
Deer Creek State Park	654-0171
Concessionaire	--------
Reservoir Administrators	
Department of the Interior	538-1467
Central Utah Water Conservancy District	226-7100

LAKE REPORTS